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Studies on Bridle Lengths in One-Boat Midwater Trawling

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Investigations on the comparative fishing trials to study the effect of bridles for a 10.5 m four equal panelled one-boat midwater trawl are described. Three bridle lengths of 20, 30 and 40 m were tested for relative efficiency evaluation. 30 m bridles are found to be more suitable for the particular design and arbitrary selection of bridle length would be detrimental to the efficiency of nets.

Larsson (1964) while discussing the relative merits and demerits of one-boat and two-boat midwater trawls has opined that the warps in front of the trawl frighten the fish away from the trawl mouth to a certain extent, in the former case. To overcome this he suggested lengthening of the pulling lines between the trawl boards and trawl net. Scharfe (1964) observed insufficient width of the area swept as one of the draw backs in one-boat midwater trawling and as a remedial measure suggested lengthening of the bridles to increase the distance between otter boards, without unduly stretching the net itself side ways. Okenski (1964) while discussing universal one-boat midwater trawl described test results of three lengths for his midwater trawl. Realising the importance of proper lengths of bridles for midwater trawls the present study was undertaken.

The authors (Mhalathkar *et al.*, 1975) in their earlier communication have published results of a new one-boat midwater trawl. The present investigations are aimed to arrive at more effective bridle length for the 10.5 m four equal panelled midwater trawl. Results of comparative fishing efficiency with the three sets of bridles are reported.

Materials and Methods

A tested design of 10.5 m four equal panelled mid water trawl with 120x60 cm vertical curved otter boards described by Mhalathkar *et al.* (1975) was used.

Bridles of 20, 30 and 40 m made of 12 mm dia. polyethylene ropes were employed. The length of the foot rope bridles was slightly longer (0.5 to 1 m) as compared to the head rope bridles and the depressors were attached midway of the foot rope bridles. The rigging of the bridles to the net and otter boards was similar to that described by Mhalathkar *et al.* (1975).

Each day the three selected lengths of bridles were rigged by regular rotation for the same net, otter boards, number of floats on the head rope and the weight of the depressors on foot rope bridles were kept constant for all the fishing operations. 38 comparative hauls were made during the course of 21 days from a 15.4 m vessel with 82/102 H.P. engine. The data on warp tension and horizontal spread were collected in the manner described by Benyami (1959), Deshpande (1960) and Satyanarayana & Nair (1965).

The results of the investigation with three lengths of bridles are given in Table 1, which indicate that 30 m bridles is better suited for the trawl under reference.

For comparing the efficiency of the nets with different bridle lengths, data were collected on catch, horizontal spread and tension on warps offered by each of the rigging pattern, namely, with 20, 30 and 40 m length in a regular rotation. 21 fishing voyages were conducted but for analysis of variance data on catch and tension from 17 voyages and

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Table 1. *Operational data with different lengths of bridles for* 10.5 *m equal midwater trawl net*

Length of bridles (m) H.R.	20	30	40
F.R.	20.5	31	41
Number of hauls	38	38	38
Depth range m	25 to 40	25 to 40	25 to 40
Warp-depth (scope) ratio	1:4¼	1:5¼	1:5¼
Towing speed knots	2.75	2.75	2.75
Total towing duration h	28	28	28
Average warp tension (on both warps) kg	592.40	561.10	594.90
P. C. horizontal spread (average)	43.26	34.88	32.00
Total catch kg	1838.40	2460.70	1797.25
Catch per hour kg (average)	65.70	87.96	64.20

(H.R.=Head rope; F.R.=Foot rope)

Table 2. *ANOVA for horizontal spread*

Source	ss	df	ms	F
Total	2562.3741	95		
Between bridles	1655.9731	2	827.9865	F=279.72** (2,30)
Between trips	631.9282	15	42.1285	
Interaction (bridles x trips)	88.9508	30	2.9650	
Error	185.5220	48	3.8650	
Critical difference for bridle means		=1.2417 m		
Average % horizontal opening 20 m bridle		=42.06 m		
30 m bridle		=35.88 m		
40 m bridle		=31.97 m		

Table 3. *ANOVA for catch*

Source	ss	df	ms	F
Total	11.8147	101		
Between bridles	0.3678	2	0.1839	F=2.62 (2,32)
Between trips	6.0848	16	0.3803	
Interaction (bridles x trips)	2.2501	32	0.0703	
Error	3.1120	51	0.0610	

horizontal spread from 16 voyages are only considered. In order to frame the ANOVA table, data on catch are converted to their logarithmic values. Tables 2, 3, 4(a) and 4(b) give the analyses of variance of horizontal spread, catch and tension on port side and starboard side of boat when the net rigged with 20, 30 and 40 m bridle lengths respectively. As the purpose of the investigation was to determine the most effective bridle length which would give higher vertical spread and catch, in all the ANOVA tables prepared, comparisons were made by taking the bridle mean square with interaction (bridles and trips) mean square.

In the case of horizontal spread obtained (Table 2) the ratio of bridle mean square to interaction mean square works out to be F (2,30) = 279.72 which is highly significant

Table 4 (a) *ANOVA for tension on port side*

Source	ss	df	ms	F
Total	34619.85	101		
Between bridles	514.85	2	257.43	F (2,32)=1.40
Between trips	8967.85	16	560.49	
Interaction (bridles x trips)	5870.15	32	183.44	
Error	19267.00	51	377.78	

Table 4 (b) *ANOVA for tension on starboard side*

Source	ss	df	ms
Total	31851.86	101	
Between bridles	0.71	2	0.355
Between trips	6917.02	16	432.31
Interaction (bridles x trips)	7360.63	32	230.02
Error	17573.50	51	344.57

($P<0.01$). The critical difference at 5% level for the bridles works out to be 1.2417 m and the average percentage horizontal spread offered by the three nets with 20, 30, 40 m bridle lengths were 42.06 m, 35.88 and 31.97 m respectively. It could be seen that the 20 m bridle length gave significantly higher horizontal opening most probably at the expense of the vertical opening as compared to 30 and 40 m bridle lengths. Observing the catch landed, definite indications are that the vertical opening which is more advantageous for a midwater trawl, has been increased in the case of 30 and 40 m bridle lengths, but near optimum vertical opening appears to be achieved with 30 m bridle lengths, without adversely affecting the horizontal opening as it must have happened in the case of 40 m bridle length.

As evident from the Tables 1 & 2 the horizontal spread progressively reduced with lengthening of the bridles. This confirms Okenski's observation that the leg length has great influence on the horizontal opening of the net. Further it strengthens Scharfe's view that short bridles transfer the shearing force from the otter boards more efficiently to the net giving better opening width (and may decrease the opening height) which is of disadvantage to this type of trawl.

Hence it is reasonable to assess that there is a corresponding gain in the vertical opening (height) of the net with the decrease in the horizontal opening (width). As these facts plus the present results of the investigations support the views of Parrish (1959) that a large vertical as well as horizontal mouth opening is an essential feature of a midwater trawl.

As regards the catch, though no significant difference could be seen from Table 3 as the F value obtained is falling short of the 5% value. However there is a definite tendency for the value to approach the level of significance as can be seen from Table 1.

Further, in the catch though no significant difference is seen by applying the Anova technique, the actual yield with the 30 m length of bridles is about 33.95% more than with 20 m bridles and 37% more than 40 m bridles, as shown in Table 1.

In the case of the tension on warps no significant difference could be seen as evident from Tables 4 (a) & 4 (b). This fact conclusively indicates that there is no significant difference in the resistance offered by the net with the three different lengths of bridles.

The data on tension on both the warps are shown in Tables 1, 4 (a) & 4 (b) and

the average warp tensions with 20 and 40 m bridles worked out as 592.4 and 594.0 kgs respectively. There is a slight reduction with 30 m bridle length, which is negligible. This is in agreement with the contention of Scharfe (1959) that sweep (bridles) lines account for only 8% of the total resistance of the gear and increase or decrease of their lengths does not influence the total resistance.

From the above discussions it is possible that the same net is capable of landing better catch when rigged with 30 m length of bridles and hence is suitable for this particular design. Further, it also establishes the fact that the length of bridles is one of the main factors governing the shape/ contour of the net and thereby the fishing efficiency of the net. The arbitrary lengths of bridles for any given design of net may thus prove to be detrimental to the catching efficiency of the net.

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